

CLAIMS:

What is claimed is:

1. A reagent delivery system in an apparatus for processing biological samples arranged on carrier elements, the apparatus comprising a stationary reagent section having one or more reagent containers and a stationary staining section in which at least one carrier element is arranged, characterized by comprising:

a probe for aspirating a portion of reagent from a reagent container in order to dispense a predetermined amount on a predetermined carrier element; and

a probe handling device for handling the probe,

wherein the probe comprises a continuous probe tubing (101) extending through a rigid probe member (102) and providing fluid communication from a dispensing end (104) of said probe member to a pneumatic pressure regulation device and wherein the rigid probe member is adapted for cooperation with the closure of the reagent container.

2. A reagent delivery system according to claim 1, wherein the rigid probe member is arranged to cooperate with at least one reagent container in such manner that the probe may penetrate an opening covered by a septum, aspirate reagent, and withdraw from the container, and wherein the septum is adapted to regenerate as an almost tight closure of the reagent container, i.e. become substantially closed again.

3. A reagent delivery system according to claim 2, wherein the septum comprises a plurality of sectors or flaps, which are free to flex upwards or downwards thereby allowing the aspirating end of the probe to penetrate the closure and the closure to regain a closed form after retraction of the probe.

4. A reagent delivery system according to claim 2, wherein the septum comprises a plurality of sectors or flaps, which, originally, are connected by lines of weakness such that the lines of weakness will break the first time a probe is inserted into the reagent container, and, afterwards, are free to flex upwards or downwards thereby allowing the aspirating end of the probe to penetrate the closure and the closure to regain a closed form after retraction of the probe.

5. A reagent delivery system according to either one of claims 1 or 2, wherein the dispensing end of the probe is a cone in order to facilitate the penetration through the septum in the closure of the reagent container.
- 5 6. A reagent delivery system according to claim 1, further characterized in that a reagent container is provided with an identification, and that the probe handling device comprises a robotic device also comprising a sensor element able to acquire information from the identification on the reagent container, and wherein the robotic device is connected to a computer receiving the acquired information.
- 10 7. A staining apparatus for automated processing of biological samples arranged on carrier elements, characterized by comprising:
 - a reagent section comprising one or more reagent containers;
 - a staining section in which at least one carrier element is arranged;
 - 15 a reagent dispensing device for dispensing a portion of reagent onto a predetermined carrier element; and
 - a handling device for handling said reagent dispensing device,
 - wherein the reagent dispensing device comprises a continuous probe tubing extending through a rigid probe member and providing fluid communication from a
 - 20 dispensing end of said probe member to a pneumatic pressure regulation device.
8. A staining apparatus according to claim 7, wherein the pneumatic pressure regulation device include a vacuum source with which the tubing may communicate via a valve device.
- 25 9. A staining apparatus according to claim 8, wherein said valve device are operable to provide a predetermined pressure in the tubing for aspirating or dispensing a predetermined amount of reagent in the dispensing end of the tubing.
- 30 10. A staining apparatus according to any of the claims 7-9, wherein the handling device comprises:
 - a holder for holding the probe member; and

a robotic motion system for moving the reagent dispensing device between predetermined locations relative to the carrier element and the reagent containers.

11. A staining apparatus according to any of the claims 7 to 10, wherein the internal diameter of the tubing is between 1.0 mm and 2.0 mm, preferably between 1.2 mm and 1.8 mm and more preferably between 1.4 mm and 1.6 mm, such as about 1.5 mm (1/16 inch)
12. A staining apparatus according to any of the claims 7 to 11, wherein the length of the tubing is between 0.5 m and 2.5 m, preferably between 1.0 m and 2.0 m and more preferably between 1.3 m and 1.7 m, such as about 1.5 m.
13. A staining apparatus according to any of claims 7 to 12, wherein the continuous tubing is provided with a spirally wound probe tubing section.
14. A staining apparatus according to claim 13, wherein the spirally wound probe tubing section is a coiled section.
15. A staining apparatus according to claim 14, wherein the coiled section comprises at least one winding, and preferably between 5 and 30 windings, more preferably between 10 and 25 windings, and most preferably between 15 and 22 windings, such as 20 windings.
16. A staining apparatus according to any of claims 7 to 12, further including a washing station for cleaning the reagent-dispensing device.
17. A staining apparatus according to either one of claims 8 or 16, wherein said valve device are adapted to provide a connection to a fluid source providing a wash solution or cleaning fluid for washing and or rinsing the probe tubing.
18. A staining apparatus according to either one of claims 14 or 16, wherein the washing station comprises a receptacle (wash sump) able to accommodate a substantial portion of the dispensing end of the probe, and an outlet to waste.

19. A staining apparatus according to claim 18 wherein the outlet to the waste is located a distance above the bottom of the receptacle so that the wash fluid ejected from the dispensing end of the probe will wash the outer surface of the dispensing end of the probe before the wash fluid is drained to waste.

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20. A staining apparatus according to any of the claims 17 to 19, wherein said washing fluid are selectable from a plurality of fluids according to the tube cleaning requirements.

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21. A staining apparatus according to any of the claims 7 to 12 or 16-20, wherein the reagent section comprises a reagent rack providing a plurality of compartments for a plurality of reagent containers or container assemblies and wherein the cross-section of a compartment cooperates with the cross-section of the container or container assembly.

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22. A staining apparatus according to claim 21, wherein the cross-section is an unsymmetrical polygon, such as a rectangle, with one corner-section replaced by a slanted/oblique fifth side.

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23. A staining apparatus according to claim 22, wherein a top wall of a reagent container is provided with a label comprising information identifying e.g. type of reagent, container volume size, date of delivery, date of end of use, and wherein the robot head further comprises an optical sensor, able to provide the information on the label to a computer system.

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24. A staining apparatus according to claim 22, wherein an electrically conducting member of the reagent dispensing device is connected to an electronic circuit adapted for capacitive level sensing.

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25. A staining apparatus according to claim 22, wherein the computer system will issue an order for a new delivery of the reagent if the level is below a predetermined limit.

26. A staining apparatus according to claim 22, wherein the computer system is connected to a plurality of staining apparatuses,

wherein the computer system uses the reagent dispensing device to detect the level of reagent fluid in each reagent container,

wherein the computer system is arranged to let the robotic system with the level sensor and the optical sensor update information about the available amount of reagent in the reagent containers in the plurality of staining apparatuses before starting a staining procedure,
5 and

wherein the computer system is arranged to recommend to an operator that a tissue slide requiring a specific reagent, be processed in a staining apparatus having a reagent container comprising the necessary volume of such specific reagent.

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27. A reagent dispensing device for use in a staining apparatus for processing of biological samples arranged on carrier elements, said device characterized by comprising:

a probe member having an aspirating and dispensing end, through which reagent may be aspirated and dispensed, and a mounting end; and

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a continuous probe tubing provided inside the probe member, said tubing extending from the aspirating and dispensing end through the entire probe member to a pneumatic pressure regulation device.

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28. A reagent dispensing device according to claim 27, wherein the internal diameter of the tubing is between 1.0 mm and 2.0 mm, preferably between 1.2 mm and 1.8 mm and more preferably between 1.4 mm and 1.6 mm, such as about 1.5 mm (1/16 inch).

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29. A reagent dispensing device according to claim 27 or 28, wherein the length of the tubing is between 0.5 m and 2.5 m, preferably between 1.0 m and 2.0 m and more preferably between 1.3 m and 1.7 m, such as about 1.5 m.

30. A reagent dispensing device according to any of the claims 27 to 29, wherein the continuous tubing is provided with a spirally wound probe tubing section.

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31. A reagent dispensing device according to claim 30, wherein the spirally wound probe tubing section is a coiled section.

32. A reagent dispensing device according to claim 31, wherein the coiled section comprises at least one winding, preferably between 5 and 30 windings, more preferably between 10 and 25 windings, and most preferably between 15 and 22 windings, such as 20 windings.
- 5 33. A reagent dispensing device according to any of claims 27 to 32, wherein the mounting end of the probe member includes a fitting for mounting the device to a probe holder on a probe handling device, such as a robotic head that is part of a computer controlled robotic system in a staining apparatus.
- 10 34. A reagent container for use in a reagent delivery system in an apparatus for processing biological samples arranged on carrier elements, the apparatus comprising a stationary reagent section having one or more reagent containers and a stationary staining section in which at least one carrier element is arranged, the container, characterized in that the cross-section of the container is a non-symmetrical polygon.
- 15 35. A reagent container according to claim 34, wherein the cross-section of the container is a rectangle with one corner-section replaced by a slanted/oblique fifth side.
- 20 36. A reagent container having a box-like form, comprising a bottom wall, four side walls and a top wall, and wherein on corner section is replace by a single slanted/oblique sidewall, ensuring a specified orientation of the container when inserted in a corresponding compartment a reagent container rack, arranged to accommodate a plurality of containers in rows and columns.
- 25 37. A reagent container assembly for use in a reagent delivery system in an apparatus for processing biological samples arranged on carrier elements, the apparatus comprising a stationary reagent section having one or more reagent containers and a stationary staining section in which at least one carrier element is arranged, the container assembly , characterized by comprising a covering or shell forming an adapter which is able to
- 30 accommodate a reagent container and further characterized in that the cross-section of the assembly is a non-symmetrical polygon.

38. A reagent container assembly according to claim 37, wherein the cross-section of the assembly as well as of the reagent container is a rectangle with one corner-section replaced by a slanted/oblique fifth side.

5 39. A reagent container assembly according to claim 37, wherein the reagent container comprises a closure comprising a plurality of sectors or flaps, which are free to flex upwards or downwards thereby allowing the aspirating end of the reagent dispensing device to penetrate the closure and the closure to regain its closed form after retraction of the probe.

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40. A method of aspirating and dispensing reagents on a plurality of samples on carriers (tissue slides) in an automated tissue staining apparatus having a slide section, a reagent section and a probe mounted on a robot head of a computer controlled robotic system, characterized by comprising at least one action from the group consisting of: beginning
15 X-movement of a robot head, moving the robot head an appropriate distance along an X-axis for a probe wash location, ending X-movement of the robot head, beginning Y-movement of the robot head, moving the robot head an appropriate distance along an Y-axis for a probe wash location, ending Y-movement of the robot head, beginning Z-movement of a robot head, lowering a probe tip into a wash area, ending Z-movement of
20 the robot head, switching a valve to activate a probe wash source, opening a valve to begin flow of a wash liquid from the probe wash source, wash the probe, closing a valve to end flow of a wash liquid from the probe wash source, beginning Z-movement of a robot head, raising the probe tip, ending Z-movement of the robot head, beginning X-movement of a robot head, moving a robot head an appropriate distance along an X-axis
25 for a desired reagent container, ending X-movement of the robot head, beginning Y-movement of a robot head, moving a robot head an appropriate distance along an Y-axis for a desired reagent container, ending Y-movement of the robot head, beginning Z-movement of a robot head, lowering the probe tip over a desired reagent container, ending Z-movement of the robot head, switching a valve to utilize a reagent aspiration pressure
30 source, opening a valve to begin access to the reagent aspiration pressure source, aspirating reagent, closing a valve to end access to the reagent aspiration pressure source, beginning Z-movement of a robot head, raising the reagent containing probe tip, ending Z-movement of the robot head, beginning X-movement of a robot head, moving a robot

head an appropriate distance along an X-axis for a particular slide, ending X-movement of the robot head, beginning Y-movement of a robot head, moving a robot head an appropriate distance along an Y-axis for a particular slide, ending Y-movement of the robot head, beginning Z-movement of a robot head, lowering the reagent containing probe tip over a particular slide, ending Z-movement of the robot head, switching a valve to utilize a reagent emission pressure source, opening a valve to begin access to the reagent emission pressure source, emitting reagent, closing a valve to end access to the reagent emission pressure source, beginning Z-movement of a robot head, raising the empty probe tip, and ending Z-movement of the robot head.

41. A method according to claim 40 wherein lowering the probe tip over a desired reagent container comprises that the probe tip get in touch with a sealing top closure of the reagent container, and by lowering the probe a further distance the probe penetrates through the sealing top closure of the reagent container;

42. A method of aspirating and dispensing reagents on a plurality of samples on carriers (tissue slides) characterised by aspirating a plurality of predetermined volumes of a predetermined reagent, further characterised by aspirating a predetermined amount of air between each of the predetermined volumes of a reagent, in such a manner that every volume of the plurality of volumes is separated from neighbouring volumes by air bubbles.

43. A reagent container for an apparatus for processing biological samples, the reagent container characterized by comprising:

a bottle comprising a first internal volume; and
an adapter housing the bottle and having an internal surface and an external surface, the external surface mating with a receptacle of the apparatus in only one orientation of the adapter, the internal surface mating with the bottle in only one orientation of the bottle.

44. The reagent container of claim 43, wherein a portion of the external surface is identical in size and shape to a second bottle comprising a second internal volume greater than the first internal volume.

45. The reagent container of claim 43, wherein the internal surface has a projection that mates with a groove on the outer surface of the bottle.

46. The reagent container of claim 45, wherein the internal surface has a projection that is able to mate with a groove on the outer surface of a third bottle comprising a third internal volume greater than the first internal volume and less than the second internal volume.

47. The reagent container of claim 43, wherein the internal surface has a groove that mates with a projection on the outer surface of the bottle.

48. The reagent container of claim 47, wherein the internal surface has a section groove that is able to mate with a projection on the outer surface of a third bottle comprising a third internal volume greater than the first internal volume and less than the second internal volume.

49. The reagent container of claim 43, wherein the bottle has a top surface comprising:
an aperture for withdrawal of fluid from the bottle; and
an identification providing information relating to the fluid or the bottle.

50. The reagent container of claim 43, wherein the aperture is covered by a septum.

51. The reagent container of claim 43, wherein the external surface has side walls in the form of a non-symmetrical polygon.

52. The reagent container of claim 44, wherein the portion consists of five side walls in the form of a non-symmetrical polygon.

53. The reagent container of claim 44, wherein the second volume is 50 ml and the first volume is chosen from the group consisting of 1 ml, 2 ml, 5 ml, 10 ml, 15 ml, 20 ml and 25 ml.